**j0280925Instruction and Manipulatives for Solving Equations**

* **Demonstration “X in the Box” – Solving Equations Using Inverse Operation Models:** VisualActivity

Cut out a paper letter “X.” Students watch then list the steps that “X” goes through as you hide it. *Follow these steps.*

1. Put “X” in an envelope.

2. Close the envelope.

3. Fold the envelope in half.

4. Put a rubber band on the envelope.

5. Put the envelope in a small tin.

6. Close the tin.

Now ask students to recall what was ***done*** to “X” and make a list as in the one below. Work with them to make a list of steps that would ***undo*** what was done to “X”.

|  |  |  |
| --- | --- | --- |
| *DO* TO “X” |  | *UNDO* TO “X” |
| ***Put in*** envelope | ***Open*** tin |
| ***Close*** the envelope | ***Take out*** of tin |
| ***Fold*** envelope | ***Take rubber band*** ***off*** |
| ***Put rubber band*** ***on*** | ***Unfold*** envelope |
| ***Put in*** tin | ***Open*** envelope |
| ***Close*** tin | ***Take out*** of envelope |

Draw lines between corresponding actions; note that the words in ***bold italics*** are inverse operations. They should see that you begin by ***undoing*** the last operation on the ***do*** list***.***

**Alternate graphic organizer: Rainbow**

|  |  |
| --- | --- |
|  | **HIDING X** |
| ***Put in*** envelope |
| ***Close*** the envelope |
| ***Fold*** envelope |
| ***Put rubber band*** ***on*** |
| ***Put in*** tin |
| ***Close*** tin |
| **FINDING X** |
| ***Open*** tin |
| ***Take out*** of tin |
| ***Take rubber band*** ***off*** |
| ***Unfold*** envelope |
| ***Open*** envelope |
| ***Take out*** of envelope |

* **Model Inverse Operations:** Kinesthetic Activity Allow students to experiment with similar situations. Give them sets of things: (1) an “X” or some small item to ***do*** to (marbles, pennies, stickers, etc.), (2) several containers (baggies, jars, boxes, plastic containers, envelopes, suitcases, wallets, purses, etc.), and (3) other embellishments that they can use on envelopes (paperclips, rubber bands, tape, string, ribbon, etc). Tell them to make their own lists of what to ***do*** to the item or to “X” and then make lists for how they would ***undo*** those things. If they work in groups they could present what they have constructed being sure to draw lines between inverse operations and being sure to talk about those inverses.
* **Connection to Equation Solving**: *Order of Operations* tells us how to operate on the variable; inverse operations undoes those steps or *solves for the variable*. Students then see how this works with a number or variable. Prerequisite knowledge: addition and subtraction are inverse operations; multiplication and division are inverse operations.

**Example:** Use the expression 3x + 5. If we put a variable in place of “x”, we would multiply by 3, then add 5. If the expression 3x + 5 is in an equation, such as 3x + 5 = 17, then make a list like the one below that parallels what you did with the other items. Draw the line connecting inverse operations so that students can see that you have to start by ***undoing*** the last thing that was on the ***do*** list. Note that they will have to do the same inverse operation to both sides of the equation in order to actually solve for “x.” The solution is **x = 4.**

|  |  |  |  |
| --- | --- | --- | --- |
| ***Do*** to the variable |  | ***Undo*** to the variable | Do the ***undo*** steps to 17 |
| ***Multiply*** by 3 | ***Subtract*** 5 | 17 - 5 = 12 |
| ***Add*** 5 | ***Divide*** by 3 | 12 ÷ 3 = 4 |